Description

Telecommunication module comprising a system data processing means for performing at least one telecommunication activity

The invention relates to a telecommunication module comprising a system data processing means for performing at least one telecommunication activity and a first connecting means for connecting the telecommunication module to an external electronic device.

Telecommunication modules of this kind are known from the prior art. In general, and also within the context of the present invention, telecommunication modules are defined as telecommunication terminals whose functionality is limited exclusively to setting up, carrying out and terminating telecommunication connections. Telecommunication modules therefore have, for example, no man-machine interface (MMI) of their own for direct input and output of data by and to a user. For operating a conventional telecommunication module of this kind, an external electronic device is necessary which is connected to the telecommunication module via a special interface. The telecommunication activities of the telecommunication module are controlled via the external electronic device which is generally termed a control unit or "controller". Data to be transmitted via the telecommunication connection set up is transmitted by the controller to the telecommunication module and data received by the module is in turn transmitted from it to the controller. There are telecommunication modules, for example, for interfacing with mobile telecommunication networks (e.g. GSM modules for connections to GSM networks) or to fixed telephone networks (such modules are generally referred to as modems).

External electronic devices can include personal computers, in particular portable personal computers, such as laptops, as well as other devices such as measuring instruments (e.g. electricity meters, heating meters, weather stations) which can be controlled via the telecommunication module and/or transmit the measured values via the telecommunication module and the corresponding telecommunication network to a central facility.

The disadvantage of telecommunication modules of this kind is that their activities must be started by an external control device, the controller. To operate the telecommunication module, the controller must therefore always be switched on, i.e. even if only in a kind of "standby mode" in readiness for receiving an incoming call. This causes unnecessary power consumption which is undesirable particularly in the case of battery-operated control equipment.

In order to be able to adapt particular telecommunication modules to specific user requirements, there is, for example, a programming environment and interface, the so-called "MUSE platform" (MUSE: Modular User Software Environment) for the Wavecom company's telecommunication modules (see e.g. http:\\www.wavecom.com\products\index.php). This allows a user to access the operating/system software originally implemented in the telecommunication module so that he can selectively modify it. Part of this "MUSE platform" is a software development environment, a so-called "OPEN AT" package which permits the implementation of new, user-created applications in the original module system software. Information about "OPEN AT" can be found, for example, in a Wavecom publication entitled "Take Command With OPEN AT" (Copyright Wavecom S.A. 10/2001) which is available on the Internet at "www.wavecom.com\products\docs\openATstec.pdf".

Using the "OPEN AT" software development environment, new applications can be designed by a user or operator of the telecommunication module, e.g. at a PC, integrated into the system

software of the telecommunication module and then transmitted from the PC to the telecommunication module via a connection to said module. This makes it possible to assign additional functionalities to the telecommunication module on a user-specific basis.

One disadvantage of this solution is that the new applications have to be translated into the special system language of the telecommunication module, which makes it costly to create the applications. Another disadvantage is that, by implementing the new applications in the system software of the module, the system software functionality may be changed and in some cases impaired (e.g. by modifying the jump instructions or memory addresses within the system software). More serious faults in this area may in some cases even compromise the operability of the entire telecommunication module. In some circumstances, such changes in the functionality of the system software may even jeopardize approval of the equipment by the relevant authorities and/or agencies.

Based on the prior art, the object of the present invention is therefore to provide a low-cost solution for integrating into a telecommunication module additional functionalities and/or applications which can be easily created, set up, modified and/or deleted.

This object is achieved by a telecommunication module having a system data processing means for performing at least one telecommunication activity, in particular for creating and/or setting up and/or implementing and/or monitoring and/or terminating a telecommunication connection, a control data processing means for automatically executing

at least one control instruction sequence stored in the telecommunication module, said control instruction sequence initializing at least one telecommunication activity of the system data processing means, and a first connecting means for connecting the telecommunication module to an external electronic device, in particular an external control unit or controller.

In a telecommunication module of this kind, additional applications and/or functionalities are implemented in the module in the form of control instruction sequences in the control data processing means which is logically separated from the system data processing means. This means that there is no direct intervention in the system software in the telecommunication module and the basic telecommunication functionality of the telecommunication module remains unchanged. Moreover, when formulating a control instruction sequence, the internal design of the system data processing means does not need to be into account in detail or even modified. It is sufficient to be familiar with the basic functionality of the system and to know how the functions implemented there can be initialized, started or triggered by control instructions. This considerably simplifies the integration of new user-specific applications implemented as a control instruction sequence.

For processing the control instruction sequence, the individual control instructions are executed by the control data processing means. For this purpose the control data processing means are implemented, for example, in such a way that one or more telecommunication activities such as establishing a telecommunication connection, reading out certain connection parameters, transmitting information, receiving information or terminating the telecommunication connection, are initiated with a control command. As part of the execution of this control instruction, the corresponding signals are transmitted from the

control data processing means to the system data processing means. This process is comparable in principle to the initiation of this telecommunication activity by an external control device. In this way, additional functionalities, which in the case of conventional modules would require the involvement of an external unit, can be assigned to the telecommunication module by the control instruction sequence. According to the invention, telecommunication modules therefore offer the possibility of enabling telecommunication activities to be performed under the control of both the control data processing means and the external controller.

In this way the telecommunication module can, for example, independently monitor a connection, regularly request information concerning the surrounding base stations of a mobile communication network to determine the location, or regularly check a mailbox. This saves e.g. system resources of the connected control unit which, for example, can be in a switched-off or battery-saving standby state or even engaged in another tasks. For example, a telecommunication module according to the invention, which has been set up to operate in a conventional mobile communication network (e.g. in compliance with the GSM or CDMA standard), can also be used to monitor the connected telecommunication network for incoming calls by means of an application (control instruction sequence) additionally set up by a user. During this time, the associated controller, e.g. a PC or measuring instrument, can be switched off. If a telecommunication connection is required from outside, the module is able to detect this and switch on the external control device for further operation of the telecommunication connection.

If the telecommunication module is to perform only quite specific functions implemented or stored in it as a control instruction sequence (or sequences), it is possible to operate the telecommunication module,

at least temporarily, without a controller. This could be implemented, for example, for regular reading of meters and measuring instruments (e.g. heating meters, electricity meters, flow measuring equipment, weather stations), in which case the telecommunication module could then, for example, read out the corresponding measured values at regular intervals and transmit them wirelessly to a collecting point. The meters and measuring instruments do not need to possess any controller characteristics for this purpose.

The advantage of a telecommunication module according to the invention is that, due to the separation of the control data processing means from the system data processing means, the processing of a control instruction sequence (e.g. a subsequently implemented user-specific application) need not be performed inside the system data processing means. As the system data processing means is controlled via the control data processing means, for developing the control instruction sequence the emphasis has to be placed exclusively on the coherence of the control instruction sequence per se, the linking with the system data processing means being assumed by the control data processing means. This means that it is comparatively easy for new kinds of applications to be incorporated in the telecommunication module, modified or deleted.

A telecommunication module can also contain a plurality of control instruction sequences which can be either logically interlinked or independent of one another. The control data processing means assumes and coordinates the processing of the individual control instruction sequences. This can be performed e.g. serially (control instruction sequences are processed one after the other) or in parallel (in accordance with a multi-tasking method that is known per se).

The instructions which can be executed by the control data processing means can be represented in a way that is freely selectable by the telecommunication module manufacturer. However,

the control instruction sequence advantageously includes at least one Java byte code instruction, in particular a Java 2 MicroEdition byte code instruction or at least one BASIC instruction. These are essentially standardized instruction sets. The advantages of this is that a telecommunication module user does not first need to learn the module's specific control command language but can use the generally known standardized instruction sets. This simplifies the creation of applications and shortens the familiarization time for the application manufacturer or developer. The latter then only has to concern himself with the features or characteristic of the telecommunication module and how specific actions are initiated.

Efficient execution of stored control instruction sequences and efficient production of the telecommunication module can be achieved if the control data processing means includes a storage means for storing the one or more control instruction sequences and an execution means for executing the one or more control instruction sequences. This means that the application area of the telecommunication module is separated from the system data processing means, and the actual application, i.e. the stored control instruction sequence and the associated execution means, are demarcated from the system data processing means. The transition between application and system area is provided by a connection between the execution means and the system data processing means. When designing a telecommunication module, for example, this separation has the advantage that one and the same system data processing means can be used, irrespective of whether a module with or without the possibility of implementing external control instruction sequences is provided. This reduces the development cost/complexity of such modules.

In order to enable the one or more control instruction sequences stored in the telecommunication module to be formulated at least partially in one of the essentially standardized programming languages, the execution means for executing the command sequence can include an execution means for executing Java and/or BASIC

program instructions. In this way the above-mentioned advantages of using a standardized programming language can be used for creating the control instruction sequence.

In particular, the execution means for executing the user-specific application can be implemented as a Java virtual machine and/or BASIC interpreter. A Java virtual machine is an equipment-specific execution unit for programs in the so-called machine-independent Java byte code (generally designated by the suffix .class). A Java byte code of this kind is obtained if a program consisting of the actual Java programming instructions (generally designated by the suffix .java) is translated by a translation program (Java compiler). This is the normal procedure for writing Java programs and generally takes place in the development environment for the Java program, in most cases a PC (personal computer), a workstation or a mainframe. After translation, the machine-independent Java byte code is then transferred e.g. to the telecommunication module.

The Java virtual machine can also be designed specifically for executing Java instructions associated with the above-mentioned Java 2 MicroEdition. This is a modification of the Java programming language specifically for small data processing devices such as microcomputers, palmtops, organizers or even mobile telecommunication terminals.

In addition, the execution means can be implemented as a BASIC interpreter, i.e. for processing instructions associated with the BASIC programming language. Furthermore, the execution means can also be a combination of Java virtual machine and BASIC interpreter. In this case

the execution means can recognize the instruction family to which an individual control instruction belongs and then process it accordingly. In this way the advantages of the individual programming languages can be combined particularly favorably.

The execution means can comprise electronic circuits and possibly software components stored therein, these being of the type commonly used in data processing devices such as personal computers or minicomputers for comparable applications.

In order to be able to flexibly adapt the telecommunication module to the user's needs, the control instruction sequence can be advantageously created and/or modified and/or deleted by the external electronic device via the first connecting means. In this respect, the electronic device can be, for example, a personal computer (PC) on which the user-specific control instruction sequence can be developed and from which it can then be transmitted to the telecommunication module. If required, the PC can also read out again and modify or even delete the control instruction sequences/applications stored in the telecommunication module. In addition, the external electronic device can also be a measuring instrument containing facilities for implementing, modifying or deleting applications in the telecommunication module. These can in turn be set up there, for example, by a computer which can be connected to the measuring instrument, and transmitted to the telecommunication module by operating elements on the measuring instrument or deleted or modified from there.

The above-described object can likewise be achieved by a method for controlling a telecommunication module wherein the telecommunication module comprises a system data processing means for performing at least one telecommunication activity, a control data processing means, a

first connecting means for connecting the telecommunication module to an external electronic device and a second connecting means for connecting the control data processing means to a system data processing means, a control instruction sequence being additionally stored in the telecommunication module which is autonomously executed and implemented in such a way that, when executed, it initiates the one or more telecommunication activities of the system data processing means.

The method described enables telecommunication activities of a telecommunication module, which are performed by the system data processing means present in the telecommunication module, to be initiated by a control program (control instruction sequence, e.g. user-specific application) which remain stored in the telecommunication module.

The stored control instructions are interpreted by the control data processing means which then initiates appropriate actions such as starting a telecommunication activity. This method employs the advantageous principal described above of implementing control data processing means which remain separate from the system data processing means of the telecommunication module and which execute the control instruction sequences stored in said telecommunication module. The fact that access to the system data processing means takes place according to the invention via control data processing means has the advantage that, when creating the control instruction sequence, the details of the system data processing means do not need to be taken into account. This makes user-specific applications considerably easier to produce.

The controlling of conventional telecommunication modules via external control devices or controllers generally takes place via so-called AT control commands. With these AT control commands, the control unit or

controller initiates the required telecommunication activities in the telecommunication module. In order to optimize the development time for the telecommunication modules according to the invention and subsequent applications therefor, AT control commands can likewise be used, from the control data processing means, for controlling the system data processing means. These are then transmitted by the control data processing means to the system data processing means via the second connecting means as part of executing a control instruction sequence/application. As the system data processing means is generally already set up for executing the AT control commands (for control by the external controller), in some cases the configuration of the system data processing means can be taken over from conventional modules, with only slight modifications, for developing telecommunication modules according to the invention. This optimizes the development cost/complexity for modules according to the invention. A combination of AT control commands and other control commands can also be used for controlling the system data processing means. This enables the functionality of the module to be additionally extended.

An advantageous embodiment of the control data processing means emerges if the one or more control instruction sequences contain at least one Java byte code instruction, in particular a Java 2 MicroEdition byte code instruction or at least one BASIC instruction. As Java, Java 2 MicroEdition and BASIC are essentially standardized programming languages, these are particularly easy to learn or already known by the user. The use of such instructions saves user time and effort for programming the control instruction sequences and allows a degree of portability of newly developed applications between different modules.

In addition, the control data processing means may be suitable for transferring data to the external electronic device via the first connecting means. In this way an application running in the telecommunication module can then e.g. transfer data, which the telecommunication module has received via a telecommunication connection, to the connected external electronic device. This can be, for example, text, image or control data received via the telecommunication network. In this context, control data can be, for example, instructions to be executed directly or even program sections, modifications or entire applications to be implemented in the electronic device. In this way, for example, a remote user can control the external electronic device directly via the telecommunication device and initiate specific activities there. Moreover, the data transmitted from the control data processing means to the external electronic equipment can also be data which has been generated in the telecommunication module itself. This can be data relating to the existing telecommunication connection (e.g. transmission rates, transmit power, nearest base station, present call duration) but also, for example, control instructions e.g. for switching the external device on or off.

The control instruction sequence stored in the telecommunication module can be run in various ways. For example, it can be initiated by the external electronic device. In addition, execution of the user-specific application can be initiated by establishing a connection from the telecommunication module to a power supply device. This means that, for example, when the telecommunication module is plugged into the appropriate mounting facility of a computer or measuring instrument, an application such as searching for a connection to a communication network is executed automatically. It is also possible for a corresponding application to be initiated both when establishing a connection to a power supply device and by the external electronic device.

In addition, the control instruction sequence can be implemented in such a way that the instruction sequence or part thereof, can if necessary be repeated at least once after a specified intervening time period has elapsed. This multiple execution of an application, or part thereof, is suitable e.g. for monitoring a telecommunication connection or for implementing a standby mode in which the telecommunication module, for example, regularly checks only whether a connection request from the telecommunication network to the module is present.

Another possible application for using telecommunication modules in wireless communication networks such as, for example, a GSM network, is independent regular checking of the connection data to the surrounding base stations by the module. This data can then, for example, continue to be transmitted to the external electronic device or can be transmitted by SMS (Short Message Service) to a particular receiver in the telecommunication network for determining the location of the module. In the second case, the external electronic device would not be involved in the application in any way.

Further preferred embodiments will be set forth in the sub-claims.

The invention will now be described in exemplary fashion with reference to the accompanying drawings in which:

Figure 1 shows a block diagram of the telecommunication module according to the invention.

Figure 1 shows by way of example the basic configuration of a telecommunication module 10 according to the invention. This comprises, in the area of the system data processing means 20, 22, 24, an area for storing and executing the actual module system software 22 which controls the operation of the basic telecommunication activities of the module 10. The system data processing means 20, 22, 24 also includes an AT command interpreter 20 which translates AT control commands to the module's system language and transfers them between AT command interpreter 20 and system 22 via the connection 24. The telecommunication module 10 additionally comprises an area for executing control programs (script interpreter) 30 which in this context are also known as scripts. One or more control programs or scripts are stored in the memory 32 and transferred from there via the connection 34 to the control data processing means referred to as a script interpreter. Depending on the instruction executed, the script interpreter 30 transmits signals and/or data via the connection 26 to the AT command interpreter or via the connection 28 directly to the system area of the module or via the connection 36 to the serial interface 40 of the module. The serial interface 40, e.g. a GPRS (General Purpose Input/Output), RS 232 or V.24 interface of the module comprises electronic circuits and connection means for establishing a connection 44 to an external control unit 42, the functionality of the interface 40 also being modifiable by the telecommunication module 10.

The telecommunication module 10 illustrated is a telecommunication module 10 for a wireless mobile communication network to which the telecommunication module 10 is or can be connected via the antenna 50.

Via an external control unit 42, e.g. a PC, a new application for the telecommunication module can be transferred via the connection 44, the serial interface 40 and the connection 36 and 34 to the memory area 32

for the control instruction sequence. If the external electronic device then sends a start instruction to the script interpreter 30 to execute the control instruction sequence, or if the script interpreter 30 starts the control instruction sequence itself, the latter loads the relevant control instructions from the memory area 32 via the connection 34 and executes them accordingly. If the control instruction indicates, for example, that a particular telecommunication activity is to be initiated via an AT command, the script interpreter 30 transmits the corresponding AT command via the connection 26 to the AT command interpreter 20. The latter in turn forwards the data corresponding to the AT command via the connection 24 to the system area 22 of the telecommunication module. The module system then performs the corresponding communication activities via the antenna 50. Data received in this process can in turn, for example, be fed back via the connection 28 from the system area to the script interpreter area. This can either process the corresponding information or forward it via the serial interface 40 to the external unit 42.

Using a telecommunication module 10 as shown in Figure 1, it is possible, for example, to locate the telecommunication module 10 in a GSM mobile network without involving the external controller 42. For this purpose a control instruction sequence stored in a memory area 32 is formulated in such a way that the telecommunication module 10 periodically solicits connection information such as channel number, adjacent cells or receive level of the current cell via the execution of specific AT commands. The information is transferred from the module system 22 to the script interpreter 30. The control program is moreover designed in such a way that it causes this data to be transmitted by SMS from the module system 22 via the antenna 50 to a remote receiver which uses this information to determine the location of the telecommunication module.

The outputting of strings to an external display unit, for example, can also be implemented in a similar way.

In addition, for example, an application which, at least among other things, forwards control instructions received via the telecommunication network for controlling the external unit 42 to said external unit 42 can be set up in the memory area 32 of the module 10.

The present invention describes a telecommunication module and a method for operating a telecommunication module which includes control data processing means for automatically executing at least one control instruction sequence stored in the telecommunication module, the one or more control instruction sequences being implemented in such a way that, when executed, they initiate at least one telecommunication activity of the system data processing means of the telecommunication module. Through the possibility of integrating and running applications in the telecommunication module independently of the operating system of said telecommunication module, the possible uses of telecommunication modules are significantly increased. This additionally makes it possible, in particular, for simple monitoring activities of the controller normally connected to the telecommunication module to be transferred to said module, thereby reducing the controller workload. In this way the actual activity of the controller (e.g. measuring instrument or PC) can be speeded up and the energy resources of the controller can be protected. For standard applications it is additionally possible to dispense with an external controller and to implement the control activities via control instruction sequences within the module.

Reference character list

10	Telecommunication module
20	AT command interpreter
22	Module system software (Telecom)
24	AT interpreter / system transition
26	Script interpreter / AT interpreter transition
28	Script interpreter / system transition
30	Script interpreter
32	Script memory
34	Script interpreter / script memory transition
36	Script area / serial interface transition
40	Serial interface
42	External controller
44	Serial interface / controller transition
50	Antenna